MASTIGOCLADOPSIS REPENS (NOSTOCHOPSACEAE), A NEW CYANOPHYTE FROM SPANISH SOILS.

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ABSTRACT - *Mastigocladopsis repens* sp. nov. from a calcareous soil in Punta de la Mora, Tarragona, Spain, is described. It is a Stigonematalean blue-green alga with both true simple lateral and V-shaped reverse branches, depending on the slope of the division septum. Comparison with related species is presented.

RÉSUMÉ - *Mastigocladopsis repens* sp. nov. est décrite d'un sol calcaire provenant de Punta de la Mora, Tarragona, Espagne. Cette algue bleue Stigonématale est caractérisée par de véritables ramifications, simples ou en V renversé selon l'inclinaison de la cloison. Le nouveau taxon est comparé aux autres espèces du même genre.

RESUMEN - Se describe *Mastigocladopsis repens* sp. nov. procedente de un suelo calcareo de Punta de la Mora, Tarragona, España. Se trata de un alga azul Estigonematal que presenta ramificaciones verdaderas, dependiendo de la inclinación del plano de división el que sean laterales simples o en V invertida. Se presenta la comparación con especies próximas.

KEY WORDS : new species, Cyanophyte, *Mastigocladopsis*, reverse V-shaped branching.

INTRODUCTION

The genus *Mastigocladopsis* with the type species *M. jogensis* was described by Iyengar & Desikachary (1946) with material found growing on submerged stones in a running stream in India. They adscribed it to a new family: Mastigocladopsidaceae. The main characteristics are: trichomes sheathed with both reverse 'V' shaped and simple lateral branchings; trichomes have a single row of cells and heterocytes are intercalary, lateral or terminal. The new family differed from the Nostochopsaceae by the presence of reverse V-shaped branches. They also stated that *Hapalosipho t laminosus sensu* Seurat et Frémy (*non* Hansg.) belongs to the former genus because of the lateral heterocyte, although they did not find reverse V-branching.

Bongale (1987) described a new *Mastigocladopsis*, *M. sogalensis*, also attached to submerged stones in running waters, differing in both the shape and the size of cells and heterocytes. The thallus in all species described so far is soft, macroscopic, globular to irregularly lobed and up to 4 cm in diameter. *M. jogensis* was not found again until Hoffmann (1990) rediscovered it in a small

stream in Corsica; he described the morphology of the sample and discussed the taxonomic position of the genus.

Anagnostidis & Komarek (1990), in their new systematic approach for Stigonematales, place the genus *Mastigocladopsis* within the Geitler Nostochopsaceae family, characterized by the development of lateral and terminal heterocytes and enlarged to include V-branching and reverse Y-branching type.

During a survey of soil algae in Spain we found *Mastigocladopsis*-like creeping filaments differing from all other taxa. The new species *Mastigocladopsis repens* is described in the present report.

MATERIALS AND METHODS

Samples were collected on the 7th April 1991. Cultures were started with filaments scraped from the substrate and maintained on 1% agarized BBM medium (Bold & Wynne, 1985).

Filaments were studied in the original sample and in cultures; x is the average of all 100 counts.

Material was photographed using a Nikon Optiphot microscope.

OBSERVATIONS

Mastigocladopsis repens was found on some soils at Punta de la Mora, Tarragona in the northeast of Spain: i) in a dry crust on soft powdery calcium carbonate in an abandoned open-air quarry, where it was associated with *Schizothrix calcicola* (Ag.) ex Gom., *Plectonema boryanum* Gom., *Stigonema minutum* (Ag.) Hassal ex Born et Flah. and moss protonema, ii) under a *Pinus halepensis* tree canopy, iii) on a pathway.

***Mastigocladopsis repens* Hernández-Mariné, Fernández et Merino, sp. nov.**

Thallus viridi-caeruleus, tenuis atque sparsus, caespitose. Filamenta solitaria, flexuosa, valde ramificata, ramis quidem -tam veris quam basi comformatis ad formam literae V inversae- tenuioribus quam filamentis primariis. Cellulae axillares basis efformantes ramorum nusquam elongatae. Vagina hyalina, tenuis, in filamentorum apicibus clausa. Trichomata primaria 5-12 μm lata, sphaericis, ovoideis vel polyedricis, 3-8.5 μm longis cellulis constituta. Rami 3-5.5 μm lati, cylindricis, 5-13.5 μm longis cellulis constituti. Cellulae terminales cylindricae ad extremitates rotundae. Heterocytae intercalares, filamenti latitudine aequantes, cylindricae, truncato-ovatae vel subsphaericae, 4-16 μm longae, laterales atque sessiles vel terminales in ramulorum brevissimorum apicibus. Sporae non visae. Hormogonia mobilia quidem, ramis vel filamento ruptis exsistunt.

Thallus blue-green, caespitose, thin, sparse composed of flexuous, richly-branched filaments, with both true and reverse "V" branches, narrower than the main filament (Figs. 1, 2). The cells of the main filament forming the V shaped base branching, never elongate. Thin hyaline sheath visible and closed at the end of the trichomes (Fig. 3). Main filaments up to 12.5 μm wide. There are two morphologically different types of cell. The main filament is built of large, pleiomorphic, barrel-shaped or rounded cells, 5 to 12 μm wide ($x = 7.3$, $\sigma = 1.2$) and 3 to 8.5 μm long ($x = 5.4$, $\sigma = 1.4$), length-width ratio 0.3 to 1.4 ($x = 0.8$, $\sigma = 0.2$) (Fig. 4), while the other cells, which compose the erect lateral branches and tips of the main filament, consisted of nearly uniform, long, nar-

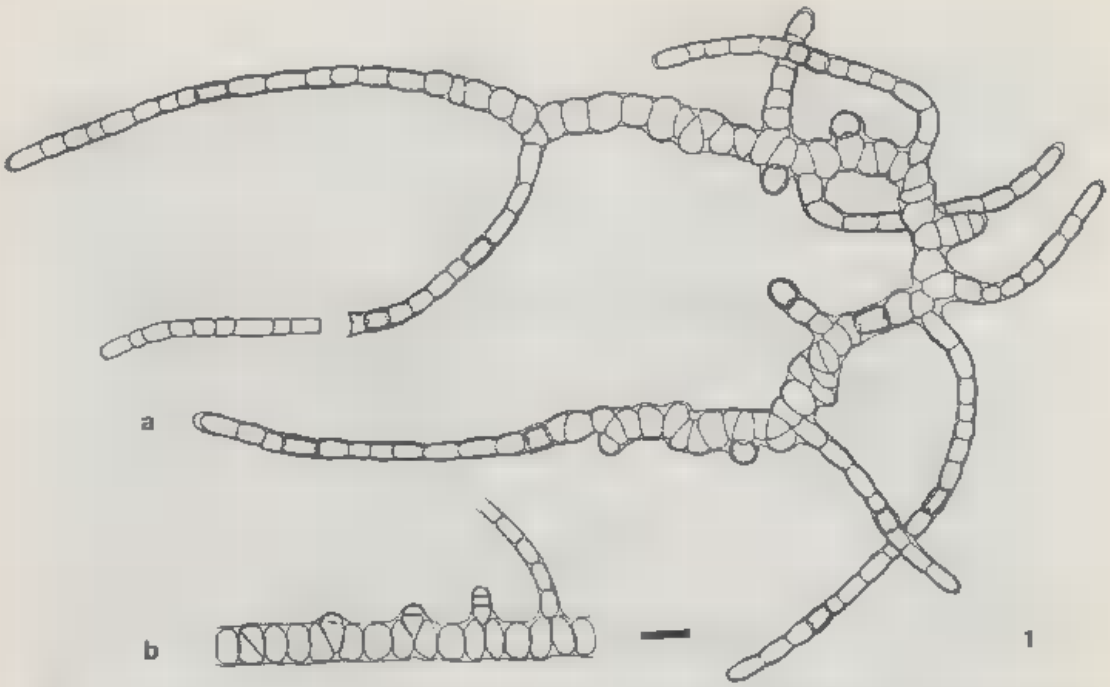

Fig. 1 - *Mastigocladopsis repens* sp. nov., field material. a: general aspect of a filament; b: sequence of reverse V shaped branching. bar = 10 μm.

row cylindrical cells, 3.0 to 5.5 μm broad ($x = 4.2$, $\sigma = 0.6$) and 5 to 13.5 μm long ($x = 8.5$, $\sigma = 2.1$), length-width ratio 1 to 3.9 ($x = 2.1$, $\sigma = 0.6$), without tapering ends. Terminal vegetative cells are cylindrical with a round tip. Heterocytes are either intercalary (Fig. 5) or lateral sessile (Fig. 6) or pedicellate (Fig. 7) on top of short branches. Intercalary heterocytes, as broad as the filament, are cylindrical, sub-cylindrical or sub-spherical, 4 to 16 μm long ($x = 7.7$, $\sigma = 2.6$); more abundant than the lateral ones, the intercalary heterocytes develop either in the main filament or in the lateral branches. Lateral heterocytes are subconical to spherical and have a diameter of 5-12 μm, they only occur on branching trichomes. Spores not observed.

Hormogonia are formed from the narrow lateral branches and the main filament tips by breaking away from the parental trichoma.

Etymology: The specific epithet *repens* is from the Latin for "creeping"

Holotype: Material deposited at the Facultatis Pharmaciae Universitatis Barcinonensis (BCF) (n° 172-6).

The description is based on wild material. In the cultured material differences between the main filaments and the branches are smaller. The cells are barrel shaped, up to 18 μm wide with length-width ratio 2.1.

DISCUSSION

The branching habit is the same for all *Mastigocladopsis* species described except for *M. fremyi* Iyengar et Desikachary which has no V shaped re-

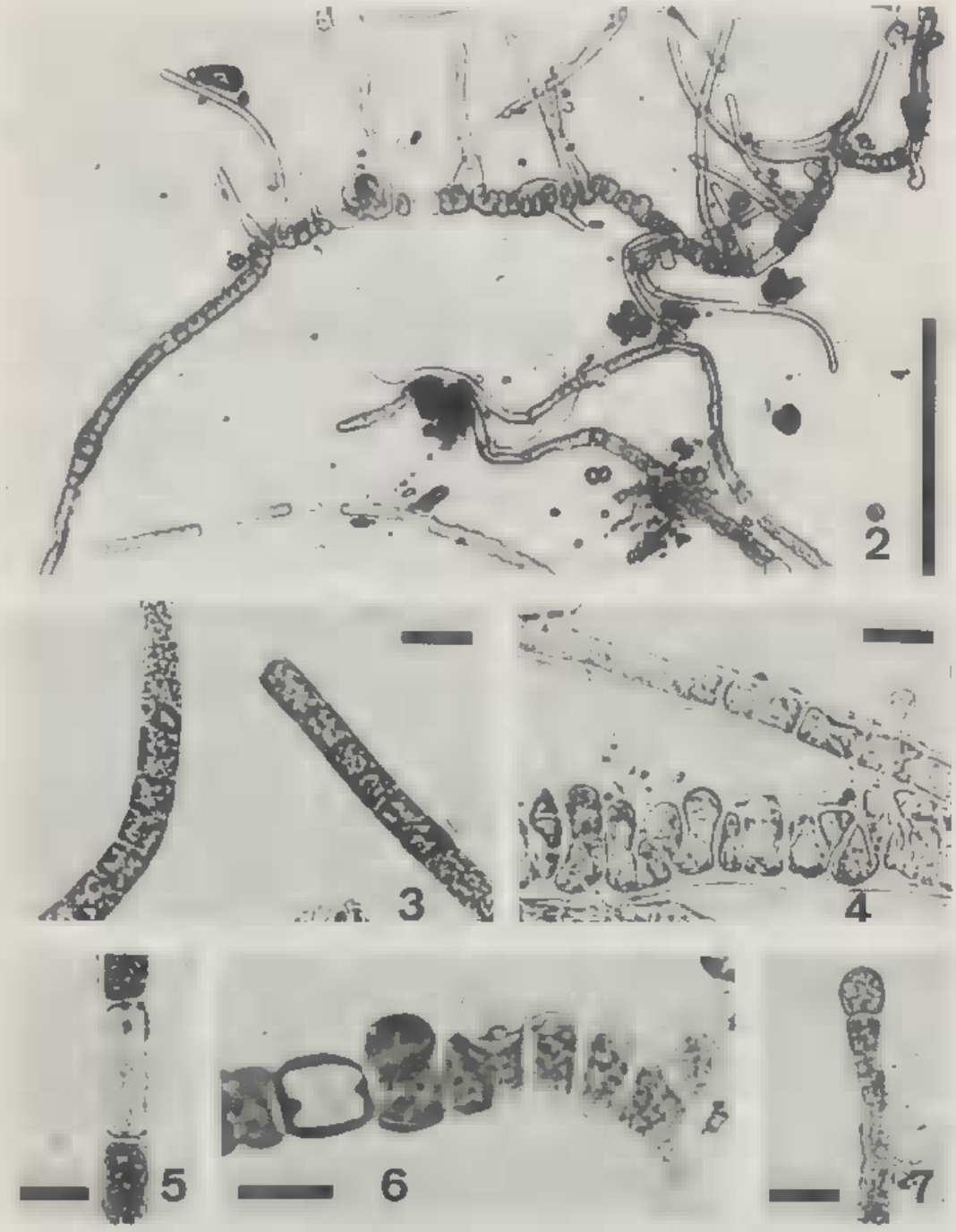

Fig. 2 à 7 - *Mastigocladopsis repens* sp. nov., field material. Fig. 2: aspect of living trichomes. Note hormogone formation. Fig. 3: terminal vegetative cells of the branches. Fig. 4: pleiomorphic cells of the main filament. Fig. 5: intercalary long heterocyte. Fig. 6: intercalary short and lateral sessile heterocytes. Fig. 7: pedicellate lateral heterocyte. (bar = 10 μm except for Fig. 2, bar = 100 μm)

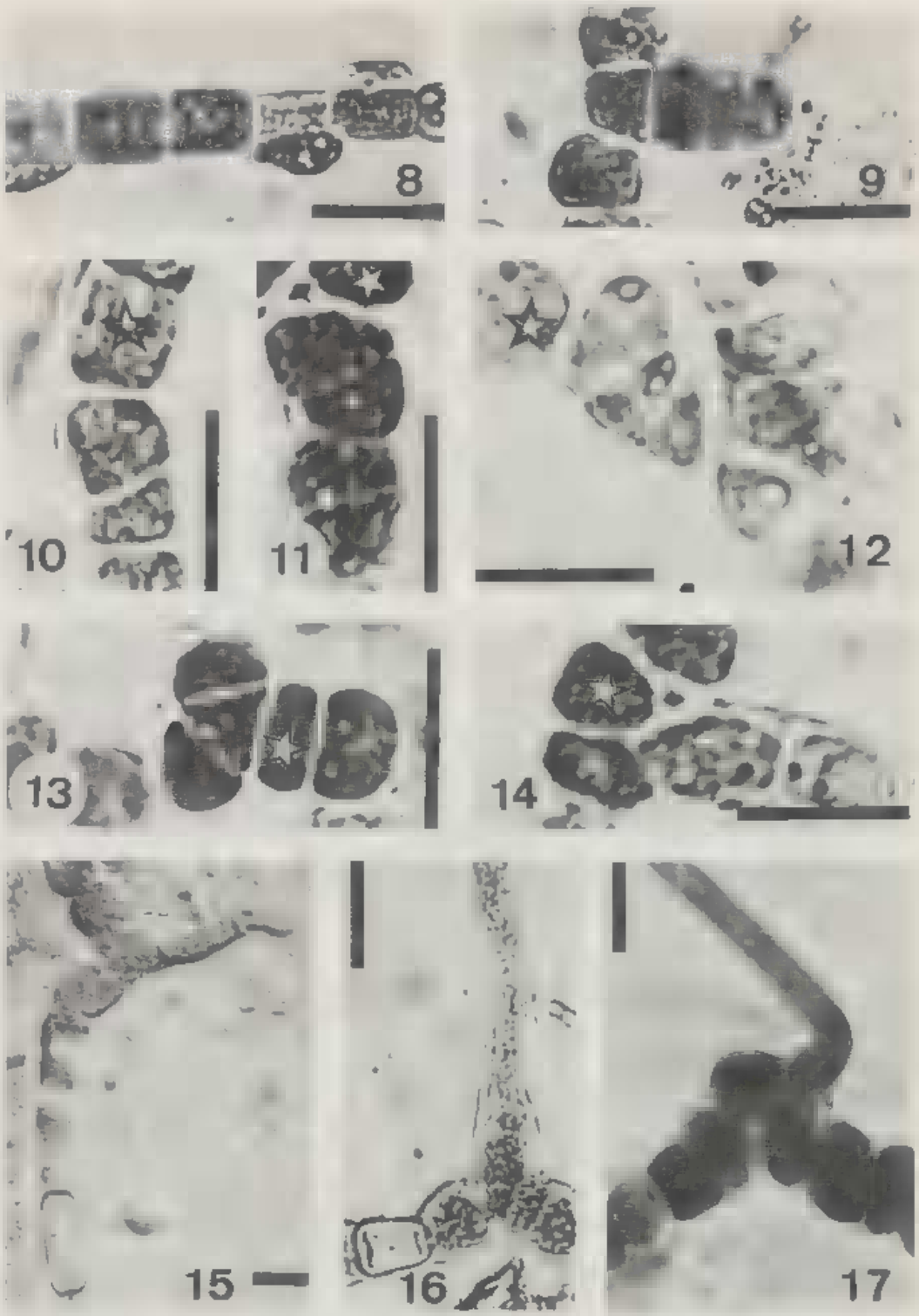

Fig. 8 à 17 - *Mastigocladopsis repens* sp. nov., field material. Figs. 8-9: sequence of true lateral branching. Figs. 10-14: sequence of reverse V-shaped branching. The basal neighbour cell is indicated by stars (see text). Fig. 15: aspect of reverse V-shaped branch under phase-contrast. Fig. 16: aspect of reverse V-shaped branch. Fig. 17: two neighbour cells are forming branches. (bar = 10 μm).

verse branches and indeed should be classified in *Nostochopsis* Wood ex Born et Flah. according to Hoffmann (1990).

Lateral branches of two kinds depend on the slope of the division septum in the main filament cells. If the septum is parallel, or nearly so, to the long axis of the filament, it causes true lateral branches (Figs. 10 to 14). If the division septum through a single cell is oblique, one of the division products and its neighbour form the V shaped base when growing. The other daughter cell maintains the connection with the two at the base and forms the branch with the next septum falling outside and above the first oblique septum, as in *Brachytrichia* (Iyengar & Desikachary, 1954). In our case the cells forming the V shaped branch base never elongate gradually (Figs. 15 to 17), unlike the other *Mastigocladopsis* species.

In Table I, the diacritical features of *Mastigocladopsis* taxa are listed. The habitat and the thallus of *Mastigocladopsis repens* are very different from other species and not even in culture does it adopt the nostochoid aspect. The main filament is wider and the length/width cell ratio is less than 1.4, whereas according to the data of other authors this ratio would be higher than 1.5. Moreover the branches are narrower and have long cylindrical cells, and the terminal cell has a round tip. The heterocytes are never wider than the vegetative cells.

The characteristics of our specimens agree with Drouet's (1981) extensive description of *Nostochopsis lobatus* Wood ex Born et Flah., although he did not mention the reverse V-shaped branching. However, neither the characteristic ecology -on limestone soil v. "clear, non calciferous, flowing freshwater streams, ditches and seepage"- nor the habit of growth -creeping on the substrate v. "more or less spherical shapes"- has ever been described in this group.

Mastigocladopsis repens fits well in the enlarged description of the Nostochopsaceae family (Anagnostidis & Komarek, 1990) except for the branches morphology. The differences between main and lateral branches are characteristic for the Fischerellaceae (Anagnostidis & Komarek, 1990). In our specimens the small cells, forming lateral branches, can divide transversally enlarging the branches. Those on the main filament, becoming bigger and having no room, have lost this property and can only divide paralely to the axis. At later stages this latter behaviour is adopted by the lateral branches. Moreover, in the cultured material the differences are smaller. The feature is thus related to the vegetative state and to the true division pattern and does not therefore justify any systematic changes.

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Species and references	#M.repens# sp. nov. This paper	#M. jogensis# Iyeng. & Desik. Iyengar & Desikachary 1946	#M. jogensis# Iyeng. & Desik. Hoffmann 1990	#M. sogalensis# Bongale Bongale 1987
Habitat	Soft powdery calcium carbonate soil	Stream submerged stones	Small stream	Stream
Thallus	Caespitose, thin	Tiny gelatinous expansions	Hollow soft colonies	Soft globular to irregular
Cell shape Main trichome	Short barrel or rounded	Long barrel	Long cylindrical	Sub-spherical to oval to cylindric
Cell shape Branches	Long cylindrical	Long cylindrical	Spherical to barrel	Long barrel?
Cell size µm Main trichome Branches	 5-12 X 3-8.5 3-5.5 X 5-13.5	 2.6-6.2 X 3.9-6.6 2-3.9 X 6.6-14.	 2-4.8 X 2.6-18 3.4-4.2 X 2.4-3.8	 4.4-8.5 wide 3.5-6.6 wide
Length/Width Main trichome Branches	 0.3-1.4 1.0-3.9	 More than 1? More than 1.5?	 More than 2? Less than 1?	 1 or more? ?
End cell shape	Cylindrical with round up	Tapering	Tapering and pointed	?
Heterocyte µm Lateral Intercalary	 5.5-9.4 ϕ 5-12 X 4-16	 3.9-6.6 X 5.2-10.5 3.9-7.2 ϕ	 6.2-9.6 X 5.4-12 ?	 6.5 11 ϕ 5.6 X 4.5-7.5

Table 1.- Comparison of the described *Mastigocladopsis* species.

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